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THE TREATMENT OF EMPYEMA BY VALVULAR DRAINAGE.

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In examining authors, and reading the different plans of treatment recommended in empyema—varying from the simple puncture with the trocar and canula to the radical operation of the Germans—one is as much amused as when gazing upon the body of the beautiful and changeable chameleon. Like the chameleon it seems to assume the color of the soil upon which it derives its nourishment. The Germans recommend one plan of treatment, the French another, the English another, and the Americans still another; but all seem to agree upon one point, and that is, that thorough drainage and ablution are the first principles, the "*sine qua non*" of all treatment.

I believe these are but *auxiliaries* in treatment.

But lying away down underneath all this, is a *first principle*—the corner-stone upon which all prognosis and treatment should be based. I allude to the *speedy obliteration of the pleural cavity by the greatest possible expansion of the lung*. This principle, and this alone, should be the one upon which all operative interference should be based.

The cure of an empyema is not affected by washing or evacuating the pus *per se*, but by the expansion of the lung and falling in of the chest-wall—one or both. The adhering together of the pleuræ brings about the object at which we aim—viz., the obliteration of the pus-secreting cavity.

This process can never take place if pus is allowed to accumulate or decompose in the pleural cavity, and only very imperfectly

if air is permitted to freely pass in and out the drainage-tube during the act of respiration. When the lung ceases to expand sufficiently to perfectly fill the pleural cavity, adhesions form between the pleural surfaces. What is the result of this? A large pus-secreting cavity; and unless kind nature bends in the chest-wall to obliterate this cavity that should have been filled by the lung, we find our patients dying from exhaustion, or going through life with a thoracic fistula. The lung, in this collapsed condition, is very prone to caseous pneumonia, and a large per cent. of cases die from this secondary malady, even after the empyema is entirely cured.

The question that should arise in every case of empyema is not, How shall I evacuate and wash this pleural cavity? but, How shall I speedily obliterate it? The principles of treatment involved in the above are—

1st. Evacuation of the pleural cavity as speedily and judiciously as possible, thus preventing the permanent collapse of the lung.

2d. Thorough ablution and disinfection.

3d. Strapping the chest with strips of adhesive plaster over the affected side, following the direction of the intercostal muscles, thus keeping the chest quiet, and allowing the pleural surfaces to unite.

4th. The introduction of a valved drainage-tube.

This keeps up pneumatic pressure upon the lung, by preventing air from entering the pleural cavity, and acting as a brace underneath the collapsed lung.

A large per cent. of these cavities are obliterated, and the patient cured by repeated aspiration, in cases where it is admissible. It should be performed often enough to allow the pleural surfaces to come in contact and not be disturbed by pressure. If the pus is fetid, warm carbolized water, one part to eighty, should be injected, and in quantities not so large as to make pressure sufficient to tear up adhesions, and all to be aspirated before the needle is withdrawn.

The aspirator and needle, which is my modification of Potani's, will be found to be the most convenient form of aspirator for washing and evacuating these abscesses, and for general use. It has a third tube with which to empty and fill the receiver, thus avoiding the necessity of removing the screw-cap; also the fluid-

tube extends to the bottom of the receiver. By this we can inject a cavity without inverting the receiver.

FIG. 1.

DESCRIPTION OF ASPIRATOR.

When an aspiration is to be made—the stop-cocks L and J—should be closed, the pump attached to the tubing (D) at the end designated with the backward pointing arrow—showing that through it the air passes into the pump. The pump upon being worked will produce a vacuum in the receiver (F). When this is achieved the stop-cock (H) should be closed and (L) opened after the needle has been introduced. As soon as the bottle is filled it can be emptied by attaching the pump at its end (B), closing the stop-cock (L) and opening (J and H). Upon working the pump the contents of the receiver will pass out through (P). By reversing this procedure an injection can be made without disturbing the screw cap (G) of the receiver; the reservoir being filled through (P) and emptied through (K) into the abscess. The needle is a combination of principles, some of which are found in other needles. It consists of three parts as seen in fig. 2. The part (7) is slid over and (O) slid into the canula (8) the aspirator being attached to the lateral tube (9)—(7) is the cutting needle furnished with a rubber packing at (5), being shorter than (8) after its introduction (8) is pushed forward through it and the joint is protected. The obturator is to dislodge obstruction in the needle during aspiration and passes through a tight rubber packing at (4). During aspiration it is drawn out beyond the lateral tube (9). Codman & Shurtleff of Boston, manufacture a needle with the same obturator, but the needle is introduced by means of an ordinary trocar. The needle attached to the tube (K) shows it ready for the operation. In aspirating pus and effusion loaded with flakes of fibrin I have not been disappointed in its use.

The needle has a movable point, with a screw packing, which prevents air from entering the cavity, and also an obturator to

dislodge any obstruction during aspiration. This instrument, and the valve drainage-tube, were made for me by J. Reynders & Co., New York, to whom I have presented the models.

The above cut and description will furnish an idea of its mechanism.

A very valuable and interesting history of aspiration can be found in Gouley's able work upon Diseases of the Urinary Organs.

In cases not cured by repeated aspirations, the "radical operation" of the Germans, or free incision into the pleural cavity between the fifth and sixth rib in the axillary line, has become a favorite one with many of our most eminent surgeons.

While this operation possesses the merit of thoroughly evacuating and cleansing the pleural cavity, it accomplishes nothing toward the obliteration of the cavity by the expansion of the lung. Pneumatic pressure is taken off the lung by the air entering the pleural cavity. Plugging the drainage-tubes does not help matters, and it certainly prevents perfect drainage.

Then the operation punishes the patient more than is necessary to accomplish the end desired, and he almost always recovers with more or less deformity, owing to the non-expansion of the lung.

Fraentzell reports five recoveries in eleven cases. Moutard Martin reports five recoveries, seven deaths, and five fistulas in seventeen cases (Ziemssen).

Caseous pneumonia was found in a majority of the cases upon post-mortem. This was probably due to the collapsed condition of the lung. If the valvular drainage had been instituted, pneumatic pressure kept up, and the lung capable of expansion, the per centage of deaths might possibly have been diminished.

Chassaignac devised an operation which consisted in making two openings into the chest-wall, one in the sixth intercostal space, the other in the fourth inter-space, 51 to 76 mm. (two or three inches) anterior to the first, and two ribs above. A perforated rubber drainage-tube was passed through the pleural cavity between the two, and tied together upon the outside of the chest. This is a favorite method with some of the English surgeons, and is highly recommended by Dr. Hingston, of Montreal, P. Q. He furnishes better statistics from it than the Germans from the "radical operation." This operation makes no application of the first principle, and from the fact that a large per centage of cases are discharged with thoracic fistulas, owing often to the accumulation of pus in

the posterior cul-de-sac below the drainage-tube, it seems as if some more perfect means should be devised. For labors in operating and furnishing to the world statistics of operations which have been verified and proven true by the operators in almost every country on the face of the earth, and which have almost completely revolutionized the treatment of purulent effusions, the profession owes its deepest debt of gratitude, not to Germany, France or England, but to the United States, in the person of Dr. Henry I. Bowditch, of Boston, Mass. He was the man who first introduced into practice capillary trocars attached to an exhaust syringe, and taught and proved that better results could be obtained in empyema from a simple puncture with a trocar and canula, and a soft rubber drainage-tube in the ninth interspace in the back, than from any other operation up to 1878.

The operation that appears to evacuate and cleanse the cavity most perfectly with the least punishment to the patient, was first performed by Drs. Baker and Southy, in Guy's Hospital, England, and reported in the January number of the London *Lancet* for 1878. They made two openings into the pleural cavity ; one low down upon the diaphragm in front ; the other between the ninth and tenth ribs in the back, as recommended by Bowditch. Rubber tubes were inserted into each opening, and the cavity thoroughly washed out by means of a rubber tube and funnel, the current of water passing from the front to the back opening. The patients recovered with but little deformity of the chest. This procedure drains and washes the pleural cavity thoroughly with as little inconvenience to the patient as possible, but the value of pneumatic pressure is completely lost sight of.

In the method which I propose, the greatest possible advantage is taken of this pneumatic pressure, by allowing no air whatever to enter from the outside during the whole time of treatment.

To accomplish this, two openings are made into the pleural cavity as recommended by Baker and Southy, and then I introduce into the posterior opening a tube which I made for the purpose, and which is supplied by a valve opening outward. This tube is made of silver, of two sizes, according to the age of the patient, is fenestrated at its extremity, and is introduced by means of a trocar. Before penetrating the chest-wall the trocar is made to pass through a rubber plate (fig. 4 D) which is applied to the outside of the chest, prevents air from entering around the tube, and,

being held in place by adhesive straps (fig. 4 G), keeps the tube in position. The valve is prevented from opening too far by a hook at the extremity of the tube (fig. 3, W). A small india-

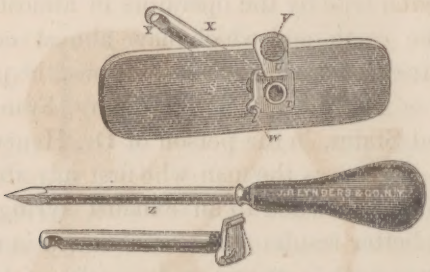

FIG. 3.—Drainage-tube, trocar, and rubber plate: S, rubber plate perforated by drainage-tube T; U, valve open; X, drainage-tube; Y, opening in same; Z, trocar. Below, tube is shown with valve closed.

rubber bag envelops the extremity of the tube and serves as a receptacle for the pus. This bag is easily cleansed by means of a stop-cock, M, in its lower extremity. If the discharge is very profuse, the pus may be drained through the rubber sac into a bottle carried in the inside lining of the vest. The tube should be introduced last, and as the pus escapes the same quantity of water should enter through the anterior tube. By this procedure the cavity will he more thoroughly washed, and no air will enter it. The point selected should be the ninth interspace in the back.

The anterior tube is introduced low enough to rest upon the diaphragm, and thus avoid the pressure upon it by the expanding lung. To do this, the pleural cavity should be explored with a hypodermic needle, to ascertain the attachment of the diaphragm to the chest-wall. The point selected should be upon a line drawn downward about 37 mm. (one and a half inches) external to the nipple upon the right side, in the sixth interspace if possible, taking care not to wound the liver and diaphragm, and 51 mm. (two inches) external to the nipple in the sixth interspace upon the left side, taking care not to wound the pericardium or diaphragm.

If, upon hypodermic exploration, pus is drawn off at the points designated, a large trocar and canula should be plunged into the pleural cavity in front, and while the pus is escaping a soft rubber-tube, 152 mm. (six inches) in length, is passed through the canula, penetrating the pleural cavity 25 mm. (one inch), when the canula is removed. The rubber tube should now be plugged, to arrest the further escape of the pus until the poste-

rior tube is introduced. With a needle pass a thread through the rubber tube close to the chest-wall and make it fast to the chest by means of adhesive straps (C). This will prevent the tube from slipping in or out.

FIG. 4. *

When both tubes are introduced, carbolized water may be introduced through the anterior one by means of a funnel and long rubber tube B as fast as the pus escapes from the posterior tube, and the cavity can be thoroughly washed without the danger of any air entering, and with the advantage of draining from the lowermost parts of the suppurating sac.

This process should be kept up till the cavity is thoroughly cleansed, indicated by the water escaping unchanged. After the cavity is perfectly cleansed, the long rubber tube and funnel is removed, and the anterior tube A is plugged with a piece of wood. The valve H, of the drainage-tube, is now dropped to its place and made fast by the hook (see W, fig 3), and the rubber bag E (a rubber condom, with a puckering string of rubber, will answer the purpose) is placed over the end of the drainage-tube F, and the lower end made fast to the chest by strips of adhesive plaster, laid on as indicated in the cut.

This rubber bag can be removed, cleansed, and disinfected, as

* Cut from Medical Record.

often as occasion may require. If the lung is incapable of rapid expansion, before dropping the valve H to its place and attaching the rubber bag allow all the fluid to escape from the pleural cavity, and air to enter it, as it will not give the patient so much distress as the weight of the fluid upon the diaphragm; then lay the patient in a position so that the drainage-tube will be at the highest point, to facilitate the air rising to it, drop the valve H to its place, and direct the patient to make a few forced expiratory efforts, when the excess of air will rush out of the cavity, and the valve preventing its entrance upon inspiration, pneumatic pressure is increased by the calibre of the pleural capacity being diminished, and the lung, if it is capable of doing so, will expand rapidly. The rubber bag should now be attached as described above. The patient should lie upon his back during the washing. The adhesive straps K should be so adjusted as to prevent all pulling upon the drainage-tube. The washing should be repeated as often as the temperature rises from the accumulation of pus. The valve and tube and rubber plate should be carefully cleaned as often as they become unclean, and the valve kept in a good working condition. If the tube should be too long it can be removed, and with an ordinary file and a pair of shears cut to the desired length. It should lie tight against the rubber plate to prevent articles of clothing from coming in contact with it, and penetrate the pleural cavity about half an inch, thus avoiding the irritating effect of a long drainage-tube, which is unnecessary. The piece cut from the tube should be put upon the trocar; this will keep the point of the trocar at its proper place, otherwise it would be too long for the tube. Flakes of fibrin obstructing the drainage-tube at any time should be moved aside with a stylet or a perforated catheter. If the anterior tube becomes obstructed by the lung expanding down upon it, a small catheter can be passed through the valved drainage-tube to the anterior chest-wall, and the rubber tube and funnel attached to it. By this means a current of water is conducted to the front, and the cavity is perfectly cleansed by allowing it to escape through the valved drainage-tube. Baker and Southy recommended carbolized water; temp. 100° F., one part to eighty; also Condy's fluid, and—

			Grams.
℞.	Acidi salicylici - -	ʒ i.	4
	Alcoholis - - -	ʒ iv.	128
	Aquæ - - -	ʒ xxviii.	896

M.

I have used each of these, and have no preference. They each act by disinfecting or preventing fermentation. Strong injections should be condemned.

The cure is effected by the pleuræ coming in contact and uniting, thus obliterating the pus-secreting cavity. Washing should be suspended when the discharge ceases to be fetid, and the pus healthy. When the lung is incapable of expansion—ceases to expand, or has fully expanded—the whole side of the chest should be surrounded with strips of adhesive plaster, laid on in the direction of the intercostal muscles. This will keep the side at rest, and favor union of the pleural surfaces.

Deformity of the thorax will depend upon the expansibility of the lung. If it is incapable of expansion, a large cavity which should be filled by lung, will have to be obliterated by the falling in of the chest-wall. To facilitate this process portions of rib should be resected, when the health of the patient will admit of it; but if the lung is capable of perfect expansion, and the cavity is kept free from pus and disinfected, and the valved drainage-tube kept in good working order, patients ought to, and will, recover with no deformity, and I am almost inclined to believe that a large per centage of cases which have hitherto resulted in permanent thoracic fistulas will be discharged perfectly cured.

The following case illustrates the method of treatment:

Patrick H——, farmer, Irish by birth, aged 20 years, was first seen by me March 25th, 1878. He had been suffering from pleuritis for ten days. On physical examination I found a large effusion in the left pleural cavity. He had been unable to lie down for the previous week. He complained of intense pain in the side; was somewhat delirious; tongue dry and fissured; temperature 104½°; respiration 30; pulse 130. There was considerable œdema of the left side, and also of the lower extremities. By the introduction of a hypodermic needle between the fifth and sixth rib in front, a small quantity of serum, mingled with slightly fetid pus, was evacuated. Prescribed diuretics, tonics, and blister. The twelfth day, or the third day of my attendance, I explored the effusion again lower down in the lateral region, and withdrew thickish, fetid pus. I think if I had made my first puncture at this point, I should have found pus, as it had evidently gravitated to this locality, and the serous portions floated upon it. There had been no remission of the symptoms. Temperature 104°, pulse 135, respiration 28 per minute.

March 28th, with the assistance of Dr. Mott, of Chateaugay, I introduced a trocar in the tenth interspace in the back, and 3.31 liters (three and a half quarts) of thick, decomposed, fetid pus, was discharged. The patient felt relieved, but owing to his feeble condition, the operation was deferred until the next day, when I found the effusion was as large as the day before. I introduced a rubber tube for washing purposes in the fifth interspace in front, and reopened the posterior opening. There was a discharge of 2.835 liters (three quarts) more of thick, fetid pus, making in all, at both operations 6.14 liters (thirteen pounds, or six and a half quarts). I then introduced into the posterior opening, for want of a better tube, a No. 12 catheter, 76 mm. (three inches long). the inner end just penetrating the pleural cavity; then, by means of a rubber tube and funnel, I passed through the chest 3.78 liters (one gallon) of warm carbolated water—temperature 100°, one part of acid to eighty. The mass of decomposing fibrin was, of course, washed perfectly and disinfected. After the washing the temperature fell to 100°, but, as pus accumulated, the temperature would rise to 103° or 104°, when, after thorough washing, it would again fall to 100°. The washing was repeated from one to four times during the day and night. From one to five and a half liters (one quart to one and a half gallons) of water was used each time as the temperature was high or low, and pus profuse or scanty. On the fourth day after the operation, I removed the patient on a bed to Chateaugay, where I could oversee the management of him. The abscess was discharging about half a liter (one pint) a day at this time. The lung had partially expanded, and pressed upon the anterior tube the tenth day, so that I was obliged to remove it, as it did not rest on the diaphragm. This proved to be a serious embarrasment, as by simply injecting into the posterior tube I could not reduce the temperature after washing, and the pus became more fetid. As the condition of the patient at this point was very low and critical, I did not dare risk an operation to reintroduce the anterior tube, but at each washing a No. 5 catheter was passed through the posterior tube forward to the front of the chest, and a current of water conducted through it to the anterior cul-de-sac. This answered the same purpose as the anterior tube, and by this means the cavity was thoroughly washed from one to four times a day for five weeks. The cavity at this time discharged only 60 c.c. (two ounces) a day, but during the

whole time before it discharged daily from 60 to 240 c. c. (two to eight ounces).

The patient now seemed to be improving, and washing was repeated only once a day for a few weeks, when it was stopped entirely. One serious difficulty in injecting through the posterior tube without having any escape from the cavity, was the tearing up of the new adhesion between the pleural surfaces, thus exciting inflammation. This accident did not occur after injecting through the inner tube or small catheter was commenced, as the fluid was permitted to freely pass out through the drainage-tube, and no pressure was made within the cavity. I noticed that, at the beginning of the second week from the time of operating, April 5th, the lung stopped expanding, and the pleural cavity would be filled with air, do the best I could to prevent it. Now, the cavity had to be filled, either with pus, water or air, and the air did not seem to distress the patient so much as the pus or fluid, when it was retained by plugging the drainage-tube; but it prevented the expansion of the lung. This led me to have the valved tube which I introduced the ninth day after the operation. Through this the pus and fluids could drain, and, on expiration, air rushed out of the cavity and was prevented from entering on inspiration. The lung and chest-walls being thus pulled upon from pneumatic pressure, the lung began rapidly to expand, and at the end of four months perfectly filled the cavity with scarcely any perceptible deformities of the chest, and, October 1st, six months after operating, I removed the drainage-tube and discharged the patient perfectly cured. I think the tube might have been removed at the end of the third month. The man is now at work in the silver mines of Colorado, and is perfectly rugged. Dr. Wilber, of Constableville, Dr. Wentworth, of Malone, and Dr. Chisholm, of Chateaugay, saw the patient with me, and examined him when he was under treatment. By actual measurement, the amount of water passed through the chest during three months was 236 liters (sixty-four gallons.)

The patient was kept upon animal broth, milk, etc. Cod-liver oil, iron, wine and quinine were given freely. This was, I think, a case of pleuritis acutissima of the Germans.

I am very sure, as the record of temperature will show, that unless thorough ablution had been performed, and the pleural cavity speedily obliterated by the lung expansion, the patient must have died of acute ichorization of the pleural sac.

I used a great amount of ablution because the patient could stand it, but I would not recommend this as a routine for all cases. But if the discharge is fetid, I would use as much ablution and disinfecting as my patient could endure, remembering that it is the last straw that may break the camel's back.